ANALYTICAL SUPPORT FOR DEFENSE PLANNING

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The subject of "analytical support for defense planning" is a broad one. Currently, there are many types of analytical techniques available that may assist in the planning process, and defense analysts may not always agree about which ones are the most important. Since our time today is very limited, I shall select for brief discussion only a few of what seem to me to be the more significant analytical tools. While the remarks to be made are my own, they are nevertheless heavily influenced by the experience of The RAND Corporation in doing research for the Air Force during the past 15 years.

Since World War II, I think the most important development in defense planning has been the generation and use of new techniques for the systematic examination of alternative proposals for future military systems and forces -- something which at RAND we call "systems analysis." While many of the techniques are new, some of the basic concepts stem from World War II under the label of "operations research." However, in the World War II application most of the problems were rather narrow in scope, and for the most part they dealt with questions regarding how most efficiently to use equipment and forces which were already developed and procured. Systems analysis, on the other hand, is generally concerned with much more complex problems. The context is usually such that the time horizon is not "the present," but rather some 5, 10, or even 15 years into the future. This means that the focus is not so much upon operational types of questions; instead it

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is upon development and procurement decisions.

When the time horizon is extended, a host of complex problems arises which must be faced explicitly in the analytical process. The number of alternatives, and hence the number of variables, to be considered increases markedly; and usually the variables are interrelated in complex, and often subtle, ways. This in turn makes it very difficult to structure the problem in a feasible way for purposes of analysis. From an incredibly complex environment, that which is relevant to the problem at hand must be included, and that which is irrelevant excluded. Here, there are no formal rules to guide us. The experience, skill, imagination, and intuition of the systems analyst are paramount. It is at this point -- the design of the analysis -- that most systems studies either flounder hopelessly or move ahead toward success. In summary, if we can structure the problem so that the right questions are being asked, we shall be well on the way toward a good analysis.

Another major problem stemming from an extended time horizon is that of uncertainty. When we are looking 5, 10, or more years into the future, uncertainty is bound to be present in a major way; and there is little that can be done to reduce it. The analyst must therefore face uncertainty explicitly and try to devise techniques for dealing with it analytically. Use of "expected values" alone will usually not suffice. Variances must also be taken into account. But where this is not possible in a formal sense, the analyst may resort to "sensitivity analysis." That is, for values of those key parameters about which he is most uncertain, the analyst may use several levels -- not just an "expected value" -- and see how sensitive the results of the analysis are to variations in these parameters. Hopefully, a "dominant" solution might be obtained -- that is, a solution in which the ranking of the preferred alternative is for the most part insensitive to reasonable variations in values of the uncertain parameters.

Now what about the formal analytical structure of a typical systems analysis? There are at least five major points here: (1) Statement of the objectives to be attained; (2) Specification of the alternatives (for example, proposed weapon systems) for attainment of the objectives

at some future time period; (3) The <u>cost</u> <u>implications</u> of the various alternatives; (4) A <u>model</u> or set of relationships among the objectives, the alternatives, and the costs; and finally, but most importantly, (5) A <u>criterion</u> for choosing the preferred alternative.

Usually the analysis takes one of two major forms. For a given desired level of utility (or military effectiveness) the systems analyst attempts to determine which alternative, or combination of alternatives, will do the job at minimum cost. Or, for a specified budget level, the analyst attempts to find which alternative, or combination of alternatives, will maximize effectiveness. In either case, it is clear that there are several classes of activities involved in a total systems analysis -- for example, campaign analysis to determine estimates of system effectiveness, and cost analysis to calculate estimates of the incremental resource impact of the proposed alternatives. Significant advances have been made during the past 10 years or so in both these realms.

You may well ask whether systems analysis has in fact contributed substantively to long-range military planning in the past. I think the answer is clearly "yes"; but the contribution has not been uniform over the broad range of military planning problems. Systems analysis has probably been more effective in dealing with planning problems in the strategic bombing area than in most other realms. Also, it has been helpful in air defense. At the other end of the spectrum is that large and most complex area of limited war. It is here that systems analysis, in its "classical" sense, has contributed least. But this is not surprising. Limited war by definition is as much political as it is military, and it is typically interdepartmental -- Army, Navy, Air Force. Also, unlike most general war scenarios containing a very small number of major exchanges, limited wars usually imply a prolonged period of continuing conflict involving numerous actions and reactions, responses and counter-responses. In summary, limited war involves a complex of heterogeneous activities that is almost impossible to structure in a formal, analytical sense. Quantitative measures -- especially measure of effectiveness -- are most difficult to come by.

This is why at RAND we have generally not been able to tackle limited war problems by using systems analysis techniques per se. We have found, however, that analysts with experience in formal systems analysis concepts and methods can often contribute to studies of limited war in a way that other persons cannot. They may help to structure problems in a more meaningful way, and on occasion they may be able to bring a certain amount of rigor to a problem area where rigorous analysis is difficult to attain.

Being unable to generally apply formal systems analysis methods to limited war problems, we have instead resorted to war gaming. As you know, there are all sorts of war games: those with large contexts, those with small contexts; games that take only a few hours to go through, others that take weeks or months; games with very rigid rules and heavy constraints upon the players, others that allow the players a wide range of flexibility; games that are essentially "deterministic," others that make considerable use of random devices; and so on. I am also sure that you are aware that war gaming techniques in general do not come up with analytical solutions in the sense that we attempt to attain them in a systems analysis. This does not at all mean, however, that war gaming is not useful. It may be most helpful in gaining insights about possible, preferred strategies, and in some cases preferred equipments. In our limited war studies at RAND, for example, numerous war games have helped us reach conclusions regarding those conditions and areas where tactical nuclear weapons might be preferred, or even necessary. Also, they have helped us gain insights about when and under what circumstances nuclear weapons should probably not be used.

At this point, I want to pause a moment to point out that in the previous discussion I have oversimplified all too much -- particularly in one respect. You may recall that I said that in the past, systems analysis has been useful in certain areas but not in others. Today, I think the general picture is that it is becoming increasingly difficult to deal analytically with any major national security problem, including strategic air warfare. The advent of new (and very often subtle) strategies, the increasing complexity of future weapon systems

and their operational concepts, the new importance of political as opposed to purely military facets of the problem, the increasing magnitude and diversity of the threat -- all of these factors, and others, make the military planning problem more complicated than ever before.

This is why at RAND we are intensifying our search for new approaches to the problem. Currently, we are experimenting with an approach that in effect combines war gaming and formal systems analysis. The basic idea is to use war gaming techniques to gain new insights about the problem at hand -- particularly with respect to the interactions between alternative strategies and future force structures. Also, war gaming is being used to help determine those facets of the problem that might be properly "factored out" of the total complex environment and treated "on the side," so to speak, using the more classical types of systems analysis techniques. The results of these more formal analyses are then fed back into the gaming activity, and the iterative process continues. In other words, we are attempting an integrated, iterative approach that hopefully combines the relative advantages of both war gaming and formal systems analysis.

We hope that this may provide one vehicle for doing a better analytical job. On the one hand, national security problems have become so complex that one is tempted to retreat in despair from using the more formal types of analytical techniques. On the other hand, simply because the problems are so difficult, the use of such techniques is desperately needed. The problem is to find those areas where existing techniques can profitably be used, and, if possible, to develop new ones.

So far, I have given little indication of the side benefits that have come about concurrently with the development and use of systems analysis and gaming methods. These side benefits for the most part have come from new, specialized techniques whose development and use were stimulated in varying degree by the requirements of the overall analytical process. Because of the shortage of time, I shall only list a few of them here:

1. Weapon system cost analysis,

2. Total force structure cost analysis and program budgeting,
3. Monte Carlo methods,
4. New computational techniques,
5. Dynamic programming concepts and methods,
6. New concepts and methods for measuring system effectiveness.

In closing, I would like to say a few words about what analytical methods <u>cannot</u> do. First and foremost, they cannot make decisions. They are no substitute for experience, judgment, imagination, and intuition on the part of the decision-makers directly and ultimately responsible. Also, we must not forget that analysis itself is subject to many difficulties and pitfalls: the problem under study may not have been formulated correctly, with the result that the analysis is in effect addressed to the wrong questions; the criteria used for choosing among alternatives may have been wrong; key uncertainties may have been ignored; relevant alternatives may have been inadvertently omitted; and so on.

On the positive side, however, a good analysis may provide a better <u>basis</u> for the ultimate decision and thus reduce <u>somewhat</u> the need to rely heavily on pure intuition. Typically, key decision-makers are very busy people. They do not have time to carefully and systematically explore all the relevant alternatives, the interactions among the variables, the critical sensitivities, and the like. If a systems analysis can clarify these sorts of issues, it can make a significant contribution to the planning process. But I repeat, analysis can only <u>help</u>; it cannot make the ultimate decision.